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Portland, Oregon
June 18, 1975

U.S. Forest Service
Region 6

Biological Evaluation

DOUGLAS-FIR TUSSOCK MOTH
OREGON AND WASHINGTON 1974 - 1975

By

David McComb
Entomologist

INTRODUCTION

An outbreak of the Douglas-fir tussock moth caused varying degrees of damage on 690,000 acres of forests in northeast Oregon and southeast and north central Washington during 1971, 1972, and 1973. Timber killed during this period was calculated at 779 million board feet with a loss value of \$26.1 million after salvage values were subtracted. An evaluation of the outbreak during the fall of 1973 indicated that defoliation of varying degrees could be expected on 377,000 acres of forests in 1974. Therefore, during the spring and early summer of 1974 an aerial application of DDT was made to the infestation on 166,000 acres in Oregon and 185,000 acres in Washington. Tussock moth population measurements showed a reduction of 98.8 percent within 21 days after the area was treated. Feeding in the sprayed area ceased immediately and overall tree condition by the fall of 1974 was significantly better in the treated areas than in the untreated areas.

Tussock moth surveys, reported on in this biological evaluation, were undertaken during the summer and fall of 1974 in the current tussock moth outbreak area and in areas of Oregon and Washington with records of past tussock moth infestations. The primary objective was to locate areas where the tussock moth was active. If or when such areas were located evaluation surveys would be expanded to secure data to determine the potential for future damage.

Personnel from the Oregon Department of Forestry, the Washington State Department of Natural Resources and the Colville Indian Agency cooperated with Insect and Disease Management, State and Private Forestry, Region Six, USFS in conducting the surveys and in the evaluation of the data collected.

Causal Agent

Scientific name - *Orgyia pseudotsugata* Mc Donnough
Common name - Douglas-fir tussock moth

Host Trees

Two species of trees on which the defoliation by the tussock moth has been heaviest and which can be considered its preferred host in the present infestation are:

Douglas-fir - *Pseudotsuga menziesii* var. *menziesii*
Grand fir - *Abies grandis*

Other species of trees in the infested area on which the tussock moth has been feeding and defoliating to a lesser degree are:

Subalpine fir - *Abies lasiocarpa*
Engelmann spruce - *Picea engelmannii*
Ponderosa pine - *Pinus ponderosa*
Western larch - *Larix occidentalis*
Western hemlock - *Tsuga heterophylla*

Damage

Newly hatched larvae crawl to the end of the branches and feed along the rib on the undersides of the current (new) year's needles causing them to shrivel, turn brown, and fall off later in the year. As the larvae mature they turn to feeding on both old and new foliage and consume the entire needle.

The killing of the new foliage by the small larvae is both rapid and devastating in appearance. This may be misleading as the loss of only the current year's foliage may not be of vital importance unless it is on trees where defoliation occurred on the previous year, in which case, the loss of the current year's growth is usually of paramount importance.

As the larvae mature their rate of feeding increases. When large populations of the moth larvae are actively feeding, entire trees may be stripped of all foliage within a few weeks. When all foliage has been consumed the caterpillars crawl to adjacent trees where feeding continues until the larvae reach the stage where they pupate.

Complete or near complete defoliation of a tree results in death while defoliation of a lesser degree often results in top-kill and retardation of tree growth.

Current Outbreak History

In the spring of 1970, 19 tussock moth larvae were found in collections from the defoliator monitoring plots in northeast Oregon. Collection counts on these plots in 1971 increased to 84 but no visible defoliation was recorded in Oregon during the annual aerial insect detection surveys. However, property owners on the east slope of Mt. Emily near Summerville, Oregon reported in 1972 that tree-killing had occurred during the summer of 1971 on approximately 20 to 40 acres of fir stands.

The larval counts on the beating plots jumped from 79 in 1971 to 468 in 1972 with larvae being found on 10 of the 13 monitoring plots between La Grande and Pomeroy. Firs along the Grande Ronde Valley were noticeably off-color by the end of June, and by late July, Douglas-fir and true fir stands between Pomeroy and La Grande had turned red as though a forest fire had run through them.

In the summer of 1971 severe defoliation of Douglas-fir occurred on several widely scattered locations on the Wenatchee and Okanogan National Forests in north central Washington. Extensive top-killing and tree mortality occurred on 1,500 acres of National Forest and private lands near Cashmere, Washington. Surveys revealed that most of the moth population had died in the late larval instars during July or August of 1971, possibly from a treatment of DDT and lindane.

Moth egg surveys made during the fall of 1971 indicated that infestations at Riverside and Oroville in north central Washington would be active and expanding in 1972. Plans were then made to use these two areas for the field testing of DDT-substitute insecticides that showed promise for tussock moth control.

Moth egg hatch in these areas occurred early in June of 1972 and by late June, when the test insecticides were applied, the Douglas-fir foliage had turned brick red as a result of new needle destruction. In addition to these areas of known infestations, defoliation was observed at Lake Wanacutt, Lake Wenatchee, in the hills west of Oroville, at many small areas on the Colville Indian Reservation, and in several small pockets of timber in draws on the south side of Lake Roosevelt.

During the late summer and fall of 1972 a series of surveys were made of the outbreak areas to determine the capability of the overwintering tussock moth population to continue severe tree defoliation in 1973. Evaluation of the data from these surveys indicated that an unacceptable degree of defoliation would occur during 1973 on approximately 400,000 acres in the Blue Mountains and on six smaller areas totaling 33,000 acres in northern Washington. Much of this area suffered heavy defoliation during 1972 and it was predicted that further defoliation would result in additional tree mortality.

An environmental statement was developed at the end of the 1972 season and subsequently the Department of Agriculture requested the use of DDT in 1973 to control the outbreak, as did the States of Oregon and Washington, the Walla Walla Chamber of Commerce and Boise Cascade Corporation. All requests for the use of DDT were denied by the Environmental Protection Agency.

During the summer of 1973, field tests with four chemical insecticides were made on a trial basis. None of these proved adequately effective. Aerial spraying experiments with the natural virus of the tussock moth and a bacterium were also conducted and showed much promise; but additional experimentation and pilot testing was needed before they could be considered for registration and operational use.

Results of the 1973 aerial detection survey showed that tussock moth activity in northeast Oregon and southeast Washington had increased from the 173,600 acres reported in 1972 to 629,500 acres in 1973. The outbreak area on the Colville Indian Reservation in central Washington increased from 1,860 acres reported in 1972 to 36,170 acres in 1973. Scattered moth defoliation was also observed on 23,390 acres of timber adjacent to the Indian lands and in Spokane, Okanogan and Chelan Counties in Washington.

The total amount of merchantable timber killed during 1972 and 1973 in Oregon and Washington was estimated to be 3/4 billion board feet. This includes mortality in inaccessible stands or scattered-tree mortality for which salvage operations are not feasible.

Data collected from 2,241 land sections in Oregon and Washington during the fall of 1973 indicated that tussock moth populations occurred within several areas encompassing approximately 1,856,000 acres. The natural virus disease, can cause outbreaks to collapse, did increase substantially during 1973 but not early enough to prevent serious damage. Evaluation of this virus, parasites, and tussock moth egg viability were made in February and March 1974. Results indicated some portions of the outbreak would decline before additional serious defoliation occurred. However, in a majority of the outbreak areas the incidence of biological control was too low to cause a collapse of the populations before additional wide-scale tree mortality and top-killing would occur. Therefore, control action was recommended on 376,000 acres in 1974. This consisted of 263,120 acres in the Blue Mountains and the rest in central Washington.

Due to inaccessibility and adverse weather conditions, there were additional areas of host-type which could not be adequately classified on the basis of available survey data. The decision to treat these questionable areas was to be based upon aerial appraisals made by helicopter and ground checks by entomologists after the larvae began feeding in 1974.

On January 3, 1974, the Forest Service requested an emergency exemption for use of DDT to control the tussock moth outbreaks. The States of Washington and Oregon made similar requests. On February 28, 1974 the Environmental Protection Agency granted the Forest Service an exemption from the prohibited use of DDT, subject to certain restrictions and requirements. Approval was given for shipment of up to 500,000 pounds of DDT for use by the Forest Service to control the tussock moth outbreaks in the Pacific Northwest.

Region Six, U.S. Forest Service, in cooperation with the States of Oregon and Washington, the Bureau of Indian Affairs and the Bureau of Land Management, planned to aeri ally spray approximately 376,000 acres in Oregon and Washington in late May or early June of 1974. Because of their ability to more precisely apply insecticides, it was planned to use helicopters exclusively for application.

Following a late spring, 351,000 acres were treated at a rate of 3/4 pound of DDT dissolved in 1 gallon of solvent and fuel oil per acre. About 5,600 acres were treated with 1/4 and 1/2 pound rates per acre in a test of reduced dosages. All applications were made with helicopters.

The effect of the spraying was dramatic, feeding in the treated areas ceased immediately. Postspray larval population measurements showed an overall corrected mortality of 96.8 percent within 4 days. Three weeks after spraying, weighted insect mortality averages for all units sprayed was 98.8 percent. Analysis showed significant differences in the number of undamaged new needles between treated and untreated areas in most of the control units. Overall tree conditions by the fall of 1974 were significantly better in the treated areas than in the untreated areas, particularly where tussock moth populations were high.

Survey Objectives

The objective of the evaluation surveys was to determine if there were any tussock moth infestations in Oregon and Washington, either within or outside the control project area with a potential to cause unacceptable defoliation in 1975.

Areas Surveyed

Areas to be evaluated in the States of Oregon and Washington were divided into two categories; those areas within the control unit boundaries and other areas outside those units. Category one areas within the central unit were divided into five units:

1. La Grande--that portion of the Blue Mountain outbreak in Oregon west of a north-south line through La Grande and Elgin.
2. Pomeroy--that portion of the Blue Mountain outbreak located in Washington.
3. Wallowa--that portion of the Blue Mountain outbreak in Oregon north of the Elgin to Joseph highway. Includes lands in the Hells Canyon area north of Hot Point.
4. Halfway--that portion of the Blue Mountain outbreak east of Highway 30 between La Grande and Baker and south of Joseph.
5. Colville--all tussock moth outbreak areas on or immediately adjacent to Colville Indian lands in north central Washington.

Category two areas consisted of areas outside the current tussock moth infestation zones where outbreaks of the moth have a history of appearing.

Evaluation Procedures

1. Aerial surveys--Annual aerial insect detection damage survey flights are made of the timber lands of Oregon and Washington. Areas of possible tussock moth defoliation were mapped along with other forest defoliators. Maps of these surveys were provided to entomologists for further ground evaluation.

2. Tussock moth detection flights--During and immediately following the completion of the programmed suppression project, helicopter flights were made to detect moth activity immediately adjacent to the control units. If any damage was observed it was mapped and then ground-checked by an entomologist to confirm that it was tussock moth defoliation.
3. Tussock moth suppression units--In the fall of 1974, after all of the current year's tussock moth eggs had been laid, 225 trees were sampled on each of the five suppression units. These trees consisted of 60 3-tree clusters on the sprayed portion of each unit and 15 3-tree clusters on an unsprayed portion of the unit. Four whole mid-crown branches were removed and examined from each of the 1,125 trees sampled. Branches were measured to determine the foliated area and the number of new egg masses present, counted and recorded. Later the number of new egg masses per 1,000 square inches of foliage was calculated for each tree cluster.
4. Potential tussock moth outbreak areas--During the late summer of 1974, when current tussock moth defoliation was most visible, observations were made at 1-mile intervals along 2,000 miles of forest roads. These observations were made in timber stands in or adjacent to areas with a history of tussock moth infestations. At each stop the foliage was examined for tussock moth defoliation. If damage was present, it was recorded on forest maps as old or current. In areas where current year's defoliation was observed, a further ground check was made for the presence of new egg masses.

Results

1. Aerial surveys--Only one new center of infestation was recorded during the 1974 annual aerial detection survey. This center of approximately 10 acres was located in Stevens County near Daisy, Washington. Ground-checking by an entomologist indicated that the moth population had collapsed naturally by the end of 1974.
2. Tussock moth detection flights--Immediately following the programmed suppression project, detection flights mapped many areas of moth defoliation adjacent to the control units. Most of these infestations were in the Hells Canyon area on the Wallowa Unit and on the north side of the Colville Unit. In most cases suppression action was immediately undertaken. Only a few small isolated spots were left untreated where they did not pose a threat because of lack of host-type timber in the immediate area.
3. Tussock moth suppression units--Of the 375 tree clusters examined, new egg masses were found on only 14 clusters; 9 on the Pomeroy Unit, 4 on the La Grande Unit and 1 on the Wallowa Unit. Location, cluster number, unit and the number of egg masses per thousand square inches of foliage are given in Table 1. Only 4 clusters

contained enough new egg masses to meet the density requirements of .2 egg masses per thousand square inches for possible suppression. All 4 clusters were located on the Pomeroy Unit.

4. Potential tussock moth outbreak areas--Roadside observations in areas with past history of tussock moth activity recorded only one area with current year's defoliation. This outbreak is located at Mares Egg Spring on the Winema National Forest in south central Oregon. It is in an area where very light moth damage has been observed for the last 5 years. A foliage examination failed to locate any new egg masses.

Discussion

Douglas-fir tussock moth populations in the outbreak currently underway in Oregon and Washington have not been responding as one identity. In most areas the outbreak appears to have subsided due to a combination of many factors which include the chemical control program and the presence of polyhedrosis virus in late July 1974. Meanwhile, new areas of defoliation with active moth populations were appearing in late July 1974 along the breaks of the Snake River Canyon. In one area, Mares Egg Spring on the Winema National Forest, the moth has been active for the past 5 years without significant damage occurring. For unknown reason or reasons this population has never developed to outbreak proportions.

Recommendations

A single prediction of outbreak trend or recommendation for a course of action cannot be made. It is apparent that the moth is no longer a threat in much of the outbreak area. Evaluation of results of the control program, observations of virus activity and the low counts of new egg masses are viable evidence of this condition.

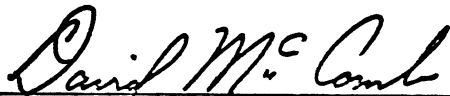
It is recommended that the only management activity required on the chemical control units, with the exception of the Pomeroy Unit, is the annual aerial detection survey. These flights should locate any small pockets of active moth populations that may have been missed during the evaluation within the control units.

Since new egg masses in small numbers were found on the Pomeroy Unit it is recommended that both aerial and ground moth detection surveys be conducted throughout this Unit during June 1975. If active outbreak centers are located they could be made available for research currently being undertaken by research entomologists through the USDA Expanded Tussock Moth Control Program.

Adequate aerial detection survey flights should be programmed to thoroughly cover all host-type stands bordering the Snake River Canyon and the Klamath Lake area of the Winema National Forest. It is anticipated that small localized areas of moth defoliation may occur in these areas. If such outbreak areas appear a new egg mass survey may be advisable during the fall of 1975. This egg survey might indicate areas for possible suppression activity or research study areas for 1976.

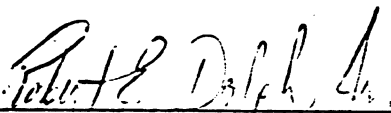
It is recommended the aerial observers be acquainted to areas with past histories of tussock moth outbreaks. Although no current damage was observed in these areas during the 1974 roadside surveys, it is possible that moth activity is occurring in areas where access is limited by lack of roads.

Written by:



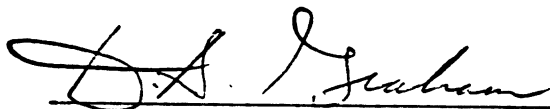
DAVID McCOMB, Entomologist
Insect and Disease Management
State and Private Forestry

Recommended by:



ROBERT E. DOLPH, Jr.
Supervisory Entomologist
Insect and Disease Management
State and Private Forestry

Approved by:



DAVID A. GRAHAM, Director
Insect and Disease Management
State and Private Forestry

TABLE 1.—Location and density of new tussock moth egg masses found on 14 of 375 tree clusters examined.

Suppression Unit	Cluster No.	Township	Range	Section	New egg Masses per 1,000 sq. in.
Pomeroy	11	7 N	43 E	31	.5
	19	9 N	41 E	7	.1
	33	7 N	44 E	3	.3
	38	8 N	44 E	22	.1
	42	7 N	44 E	4	.3
	56	9 N	42 E	9	.4
	70	7 N	45 E	16	.1
	75	8 N	44 E	25	.1
	114	7 N	44 E	1	.14
La Grande	63	2 S	36 E	2	.07
	68	1 S	37 E	33	.05
	71	1 S	37 E	17	.07
	119	1 S	36 E	24	.04
Wallowa	80	4 N	46 E	7	.05